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ABSTRACT

This study used naturalistic inquiry methods to examine reasons why some members of minority groups, despite discouraging odds, persist in the sciences or science related disciplines. Interviews were conducted with 10 African American upperclassmen majoring in natural science or science related disciplines at a predominately white coeducational research university. Subjects were questioned about their experiences within their respective disciplines and about affective factors influencing their persistence. Three generalized observations were developed from analysis of the interviews: (1) the importance of the development of self-reliance and autonomy to persistence; (2) the role uncomfortable environments play in persistence; and (3) the emphasis on the product (career prospects) of science education rather than the process of science education. Students typically expressed attitudes that were resigned, yet persistent. Among factors influencing persistence were a strong support system comprised of family, friends and home community members; parental expectation of success in college and a desire not to disappoint parents; and a focus on the quality of educational opportunities offered by the university and the necessity of taking advantage of them. (Contains 29 references.) (Author/JLS)

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Factors Influencing Persistence Among African American Upperclassmen In Natural Science and Science-Related Majors

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ABSTRACT

Historically, science careers in the United States of America have, for the most part, been the domain of White males. Reports such as, *The Condition of Education, vol. II* (Alsalam, 1990) indicate a small but increasing number of minority students pursuing natural science and science related career fields. Nevertheless, at its present rate, minority presence in the sciences and related fields will remain severely limited well into the next century. For many reasons, it has been difficult for minorities to enter science and science related fields. Not the least of these is the majority's stereotypical views of those minorities. Still, even in the face of barriers and other discouragements some minorities persist in their pursuit of these fields as career choices.

With the aforementioned in mind, the overarching research question becomes, "Why do some members of minority groups persist in their pursuit of natural science and science related career fields against discouraging odds?" This investigation of minorities was limited to 10 African American upperclassmen majoring either in natural science or science related disciplines at a predominantly White, coeducational, major research university of the Atlantic seaboard region. Demographic information was collected. Using methods of naturalistic inquiry, three, in-depth, audio taped interviews were conducted with each respondent in order to elicit pertinent information about persistence. The respondents' background, family, schooling, and other influences

on persistence were examined. The respondents were queried about their experiences within their respective disciplines. Included is an investigation of what affective factors influence their persistence in their disciplines. The audio taped data were transcribed, coded, and qualitatively analyzed utilizing grounded theory methodology with regard to the factors that influenced persistence among the respondents.

Among the many general findings, three observations about the data were developed: (1) the importance of the development of self reliance and autonomy to persistence; (2) the role uncomfortable environments play in persistence; and, (3) the emphasis on the product of science education rather than the process of science education.

It is imperative that this nation keep a greater pool of its creative talent in scientific pursuits, if it is to maintain its preeminence in science and technology. Consequently, serious examination of this question is required to provide the types of nurturing environments necessary to produce scientists from all sectors of the larger community. In the past, historically Black colleges and universities could produce as many scientists among its students as could find their place in the scientific enterprise. That is no longer true. What is now needed is an understanding on the part of other universities of this problem if the present need is to be met.

BACKGROUND OF THE PROBLEM

The enrollment of certain ethnic minorities entering four year colleges and universities in the United States is clearly underrepresentative of their number in the country. African Americans, (the largest minority) Hispanics, and Native Americans comprised 21.9% of the general population in 1990, but they represented less than 10% of the four year college and university population (The Chronicle of Higher Education, 1992). Since 1970, in response to criticism that they were not serving a large segment of the population very well, many predominantly White institutions made efforts to recruit more minorities (Smith, 1990). A frequently announced goal was that minority representation in higher education would be increased to a percentage reflective of their representation in the nation or surrounding community. But Allen (1988), observed that the four year institutions fell far short of their overall projected enrollment goals. It is not surprising then, that in 1990 of 13,000 those who were conferred a Ph.D. in science and engineering only 2% were African American (Massey, 1992).

Another matter of concern is that of those African Americans who enroll in predominantly White, four year institutions and continue to completion, only a fraction choose natural science and science related majors (Alsalam, 1990, Changing America:…, 1989, Boyd, 1974). Young (1983) postulated that minority students are present in greater numbers in humanities and social science majors

because these majors represented fields traditionally open to them:

> It is well known that the majority of blacks pursue careers in the humanities, social sciences, and athletics. One obvious reason has been that the areas of education, social work, theology, arts, and sports have been more open to blacks and thus have provided a large number of role models for young blacks to emulate. These fields have also been chosen because the disciplines themselves allow resolution of personal conflicts and pursuit of issues relevant to the black predicament. Obviously, sports are one constructive way for blacks to channel assertiveness. The disciplines in the humanities allow the individual to focus on the purpose of life, man's role in society, individual worth and expression. On the other hand, the sciences presume that the student has already resolved these issues and the emphasis is on the objective nature of truth. Studying scientific subjects results in a psychological press that often makes it difficulty for a black [person] to acquire the skills required in science while dealing with the subjective problems of his identity. (p.7).

In her analysis of African Americans in higher education, Smith (1990) similarly reported that African Americans are enrolling in social science and education majors at a higher rate than technologically based majors. This imbalance, she cautioned

limits the opportunities and options available to African Americans to increase their numbers in science related professions.

Taking note of this serious shortfall, several initiatives were taken to improve the enrollment of minority students in science. The federal government has also attempted to address the under representation of minorities in science. Melnick and Hamilton (1981) described four federally supported programs that addressed the problem. Two of the programs were funded by the National Institutes of Health (NIH). The first was the Minority Biomedical Science Program (MBS). The second was the Minority Access to Research Careers Program (MARC). Though both programs were designed to offer monetary incentives for faculty to provide funded research opportunities for minority students in colleges and universities, MARC also provided tuition remission and stipends for both pre- and post-doctoral students. MBS provided stipends for undergraduates. The National Institute of Mental Health funded a third initiative entitled the Centers for Minority Group Mental Health Program. This program trained minorities for leadership roles in the reinterpretation of minority mental health problems from the perspective of minority group members. The last program described was called the Health Centers Opportunity Program (HCOP) and was funded by the Health Resource Administration. It was designed to offer pre-professional training and financial aid to minorities interested in health professions.

Sims (1992) described some of the programs developed by the educational community designed to promote greater minority participation in science. These programs were targeted especially at minority engineering students. They were designed to provide academic enrichment, mentorship, and a sense of community to minority students. University of California at Berkeley developed one of the oldest of such programs. It was called the Mathematics, Engineering, Science Achievement program (MESA). The American Chemical Society's Project SEED (Summer Educational Experience for the Disadvantaged), the National Action Council for Minorities in Engineering program (NACME), and Notre Dame University's Graduate Engineering for Minorities program (GEM) followed shortly thereafter.

With such emphasis placed on increasing the participation of minorities in the sciences, why weren't more minority scientists produced? By considering the reflective responses of the educators, government officials and industry executives who administered these programs, Sims (1992) identified seven reasons for the failure of these programs to increase minority representation more substantially:

1. Programs were run with little oversight or assessment; funding did not depend on results.
2. There was little real commitment from the top or from most faculty.
3. Programs had vague or unrealistic goals.
4. Funding was inconsistent, magically appearing one year and vanishing the next.

5. Programs ignored subtle psychological issues, such as low expectations on the part of teachers and counselors.
6. Colleges recruited unprepared minority students and then left them to sink or swim.
7. Programs targeted college-age students or higher, instead of also going to the root of the problem in elementary and high schools.

Many of the efforts to increase minority representation in science have been programmatic and have not considered the individual as much as the group.

Not only is enrollment of African Americans a concern at predominantly White, four year institutions, but their graduation rate in natural science and science related majors is also a problem. For example, in 1989, the University of Minnesota-Twin Cities, The Ohio State University and the University of Texas-Austin respectively had the largest undergraduate enrollment in the United States. Nevertheless, during that year, none of these institutions ranked in the top 34 colleges and universities conferring baccalaureate degrees to African Americans in physical sciences, life sciences, and engineering/computer science/math (Black Issues in Higher Education, 1992). Contrast this with the three largest Historically Black Colleges and Universities, (HBCU's) Howard University, University of District of Columbia, and Southern University-Baton Rouge, in 1992 (Black Issues in Higher Education, 1992b). During 1989, these institutions ranked among the top 15 who conferred Baccalaureate degrees to African

Americans in physical sciences, life sciences, and engineering/computer science/math (Black Issues in Higher Education, 1992). More specifically, Howard, UDC, and Southern conferred degrees to their majors at a rate of 75.8%, 100%, and 100% in the physical sciences, 83.1%, 100%, 100% in the life sciences, and 77.9%, 90.4%, and 89% in engineering/computer science/math, respectively (Black Issues in Higher Education, 1992). Clearly such disparate figures suggest a major problem but also a possible source of useful information.

Another and different contributing factor to the low enrollment and graduation rate among minority be a perception of bias in the field. Among the findings of his survey of 1206 minority engineering students at 64 colleges and universities, Friedman (1990) found that although the African Americans had comparable math SAT scores to the Whites and Asians, 84% felt they faced special problems as minorities on campus. Many of these students cited the lack of role models as disturbing. Other researchers have also identified the absence or presence of suitable role models in the lives of minority students as extremely important (Wilson, 1987 & Young, 1983).

Of the African American students who chose a natural science or science related major, those who attended predominantly Black institutions were more likely to persist than those who did not. In a study of 186,000 first time, full time college freshmen, Cross and Astin (1981) looked for answers to three central questions regarding persistence. By holding certain predictors and factors constant, they investigated: (1) what effect the

student's race (Black or White) had on persistence; (2) whether students were able to persist longer in some types of educational environments than others; and, (3) what effect financial aid had on student persistence. In short, they found that (1) when holding predictors of persistence constant for both groups, race alone played little if any, significant role in persistence; (2) Black students were more likely to persist while attending predominantly Black institutions than their Black counterparts at predominantly White institutions; and, (3) Black students were less likely to persist based on financial aid and parental income constraints than White students. Cross and Astin's findings seem to offer support to those reported by *Black Issues in Higher Education* (1992). The difference in graduation rates among African American students attending predominantly White schools as opposed to those attending HBCU's indicate that persistence is aided by particular characteristics associated with HBCU's.

Unfortunately, the other studies most closely related to the question of persistence are those that directly address the issues of minority retention in the sciences. Persistence as it is used in this study, speaks to the student's efforts to remain in a science major. Retention is concerned with an educational institution's effort to decrease attrition.

The common thread running through most of the retention studies is that they examine the question of persistence through institutional responses to attrition. That approach has the affect of making these investigations failure-centered. Few studies systematically investigate why minority students succeed,

as a guide to planning programs designed to increase persistence in natural science and science related majors. More specifically, the systematic study of the self-defined factors minorities credit as contributing to persistence in sciences are absent in the more recent published literature. This study unlike most others, examined student responses to the certain institutional characteristics rather than the institutional responses to what characterizes student attrition.

This is a qualitative study. It primarily delineated the factors that a group of minority upperclassmen identified as important to their persistence in natural science and science related career fields at a predominantly White, coeducational, major research university. In addition, the study identified the institutional characteristics those students felt they had to overcome in order to persist. Secondarily, the study also identified the factors that influenced their interest in science. In order to reduce the potential for interference from intervening variables, this study of minorities was limited to African Americans. The ten African Americans in this study were people of Black African decent who had at least three generations of their ancestors born in the 48 contiguous states. Persistence in this case, was demonstrated by students who entered higher education with the desire to become natural science and science related majors as freshmen, completed the required courses leading to those majors, and formally declared such majors as upperclassmen. A major research university was defined as one that in practice, emphasized the production of original research by its faculty.

The guiding questions selected for study were as follows:

(1) What affective factors had a major influence on persistence in science, or a science related-field?

(2) What experiences in and out of college did the participants regard as having the greatest impact on their views of science?

(3) How did the presence or absence of institutional support influence the undergraduate experiences of the participants?

(4) How did the life and career goals of the participants affect their present choices?

This study also considered participant perceptions with regard to the cultural phenomena that shaped their perceptions (Tesch, 1990), of the question of persistence in science and science related areas. The use of a research design that employed aspects of ethnographic research methodology seemed most appropriate for the type of data that was collected. Like ethnography, this study examined the relationships between categories (Tesch, 1990), studied fewer subjects in greater detail (McCracken, 1988), and attempted to describe various aspects of a culture (Bogden & Biklen, 1992). Unlike ethnography, this study did not examine subjects *in situ*, from the vantage point of a participant-observer (Tesch, 1990). Since perception is actively constructed by each individual, the findings of associated with this study will be written from the constructivist perspective (Wilson, 1992).

All of the participants in the study attended the same predominantly White, coeducational, major research university. In order to protect the anonymity of the study's participants, the

institution will be referred to by the pseudonym 'Rustic University' in all subsequent references.

THE SETTING OF THE STUDY

Rustic University is a public, coeducational, state supported university of the Atlantic seaboard region of the United States. It first opened its doors to White, male, in-state residents in the late 18th century. Shortly thereafter, it admitted White males from other states. It boasts a number of 'firsts' in the nation in terms of facility construction and academic programming. In addition to its educational function, Rustic established its research and service traditions early in the 19th century. Graduate programs were initiated in the late 19th century.

Excellence in research, teaching and service in conjunction with its long history has earned the University a high ranking among colleges. It is presently ranked in the top quartile of the best colleges in the United States (US News and World Report, 1992). Although undergraduate instruction has been identified as a priority, Rustic is clearly a research institution. This is evidenced by the following excerpt from the preamble of its mission statement adopted in the 1980's:

> ...The University is a research university. Fundamental to this designation is a faculty actively involved in research, scholarship, and creative work, whose teaching

is transformed by discovery and whose service is informed by current knowledge…[1]

Rustic presently offers over 65 baccalaureate, 85 master's and 60 doctoral programs. It also confers five professional degrees. It has a student enrollment approaching 25,000 and full-time faculty approaching 2,000. The enrollment in courses offered to underclassmen is typically very large resulting in a high student/instructor ratio. It is not considered unusual for some classes to consistently enroll approximately 500 students in a single section of a course.

Rustic is located in what is best characterized as a small, 'college town'. The University is the town's major employer. In some fashion, all of the surrounding businesses are affected by the number of people associated with Rustic. This is clearly evidenced where there is well over a 50% decrease in residential population at the end of terms or during school breaks and the dormitories are closed.

Much like the student population demographics on campus, the population demographics in town present a minority population significantly smaller than the White population. By far, the largest of the minority groups in both instances is African American. However, the number of African Americans involved in highly skilled or technical science careers at Rustic represent a smaller percentage than even their small population statistics. Consequently, the paucity of role models outside the university as

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[1]Mission statement excerpted from the Rustic University undergraduate catalogue.

well as inside may tacitly discourage wider participation in the sciences among the African American students. The following section describes why a remedy to this continuing circumstance is needed.

Methodology

With the previous sections in mind, the overarching research question becomes, "Why do some members of minority groups persist in their pursuit of natural science and science related career fields against discouraging odds?" This investigation of minorities was limited to 10 African American upperclassmen majoring either in natural science or science related disciplines at a predominantly White, coeducational, major research university of the Atlantic seaboard region. Demographic information was collected. Using methods of naturalistic inquiry, three, in-depth, audio taped interviews were conducted with each respondent in order to elicit pertinent information about persistence. The respondents' background, family, schooling, and other influences on persistence were examined. The respondents were queried about their experiences within their respective disciplines. Included is an investigation of what affective factors influence their persistence in their disciplines. The audio taped data were transcribed, coded, and qualitatively analyzed utilizing grounded theory methodology with regard to the factors that influenced persistence among the respondents. Since ethnography has been and continues to be defined in many different ways by researchers with many different purposes, for this study, ethnography is defined as a means 'to describe and analyze all or part of a culture or

community by describing the beliefs and practices of the group studied and showing how the various parts contribute to the culture as a unified, consistent whole' (Tesch, 1990). This definition would indicate that ethnography is the study, analysis and description of culture. The manner in which culture is studied, analyzed and described constitutes *ethnographic research methodology*.

RESPONDENT CHARACTERISTICS

General Characteristics

All ten respondents completed the participant intake questionnaire. Their responses are chronicled in Table 1. Forty percent of the respondents had achieved senior status prior to their participation in the study. Sixty percent of the respondents were female. There were 3 biology majors, 2 chemistry majors, 2 pharmacy majors, and one each studying radiological sciences, physics, and biomedical engineering majors. All were reared in what they defined as either a rural or suburban community and attended public schools. All of the respondents reported that both parents were always actively involved in their lives, even in the case of divorced or never-married parents. The formal education of the mother was greater or equal to than that of the father in 80% of the cases. Seventy percent of the respondents had siblings. Of that 70%, all were either the youngest or the oldest child in their family. Ninety percent viewed their socio-economic status as lower middle or middle class. Sixty percent graduated from a predominantly White high

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Table 1.--Demographic Information on Participants*

Respondent[1]	1	2	3	4	5	6	7	8	9	10
Student Status[2]	Sr	Sr	Jr	Jr	Sr	Jr	Sr	Jr	Jr	Jr
Major[3]	Phar	Chem	Bio	Bio	Engr	Rad	Bio	Chem	Phar	Phys
Gender	F	M	M	F	M	F	F	F	F	M
Age	21	22	21	21	22	20	22	21	20	21
Home Community Type[4]	S	R	S	R	S	S	S	S	R	S
Mother's Education[5]	BA	MS	SC	SC	MS	SC	MS	BS	HS	SC
Father's Education	MS	Elem	SC	HS	PhD	HS	BS	BA	HS	BS
Siblings[6]	N/A	OB	OBS	N/A	N/A	YBS	YS	YB	OBS	OBS
Socio-Economic Status[7]	MC	LMC	MC	LMC	UMC	LMC	MC	MC	LMC	MC
HS-Afr. Am.:White:Other[8]	500:1	7:3:1	4:5:1	2:4:1	1:10	5:1	3:5:1	3:4:1	10:1	9:10:1
No. in HS Graduating Class	376	275	600	200	400	333	527	300	150	227
Total No. of HS Science Classes	12	8	8	8	12	8	8	10	8	10

*Presented in order of first interview

[1]Respondent identifier number

[2]Jr-Junior; Sr-Senior.

[3]Bio-Biology; Chem-Chemistry; Engr-Biomedical Engineering (Applied Sciences); Phar-Pharmacy; Phys-Physics; Rad-Radiological Science;.

[4]R-Rural; S-Suburban.

[5]Elem-Elementary School; HS-High School, SC-Some College; The rest of the designations refer to earned degrees.

[6]Respondent's perceived socio-economic status reported. LMC-Lower Middle Class; MC-Middle Class; UMC-Upper Middle Class; N/A-none; O-Older; Y-Younger; B-Brother(s); S Sister(s).

[7]Respondent's perceived socio-economic status reported. LMC-Lower Middle Class; MC-Middle Class; UMC-Upper Middle Class.

[8]Ratio of African American/White/Other in HS. When 2 numbers are reported, no 'Others' were reported.

school. All had completed high school science courses beyond the six (general science one and two, biology one and two, and another set of two science courses) that were required for entrance into Rustic University.

SPECIFIC CHARACTERISTICS

The following is a profile of each of the participants in the study:

Ann: A 21 year old senior, majoring in pharmacy. Her parents are well educated (college degree or beyond) and are employed in scientific fields. She is their only child. She was reared in what she defined as a progressive, suburban African American community. She presented a poised, self-confident persona. She spoke confidently about both her background in science, having had several classes beyond those required for high school graduation and her inquisitiveness about science.

Jim: A 22 year old senior, majoring in chemistry. Although his mother has significantly more schooling than his father, he believes that his entire family regards his father as the head of the family and respects him as such. He was educated in a small, rural high school but credits his mother with his ability to present himself positively in broader circles. He was a thoughtful respondent and viewed every activity he participated in as one that would help prepare him for greatness.

Bill: A 21 year old junior, majoring in biology. He was reared in a suburban community by parents who had attended college. He credited most of his success to the strong family

unit that sustained him. He graduated from a large high school in a neighboring community. He had a voracious appetite for learning. He changed his major several times because his interests continued to expand, not because of his inability to master any one discipline. He was also finishing a minor in French.

Sue: A 21 year old junior, majoring in biology. She was schooled and reared in a small, rural community by a single parent for most of her life due to divorce, though she believed her father to be an integral part of her life. She demonstrated little self-confidence during the interviews for this study. As she answered, she seemed to be in search of the 'correct' answer and continually looked for approval for her point of view. Her responses frequently began or ended with, 'I don't know' which she used as a qualifier.

Carl: A 22 year old senior, majoring in biomedical engineering. He was the only child of highly schooled suburban, upper middle class parents. He defined his parents as 'very demanding' but some of his responses indicated that his parents were almost domineering. He expressed an interest in asserting himself more but did not know how to do so without incurring the wrath of his parents. He was very shy, yet projected an arrogantly superior intellect when discussing his coursework.

Kim: A 22 year old junior, majoring in radiological sciences. Her family encouraged her to achieve so that her younger siblings had something to aspire to. She always demonstrated great responsibility for the progress of her family

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and community. She was very directed in her studies and wanted to go back to her community as an inspiration to other African Americans. She also wanted to shatter all stereotypes that Whites had about African Americans through her achievements.

Jane: A 22 year old senior, majoring in biology. She was part of a close knit, supportive family and she and her younger sister were inseparable. She credited her experience in a predominantly White high school as making her aware of the difference in treatment between people of different ethnicities. Her personality was as fiery as it was comedic. She would move easily between laughter about a situation to indignation about a perceived injustice.

May: A 21 year old junior, majoring in chemistry. She was a very shrewd, savvy young woman who knew what she wanted out of life. She had drawn herself a plan and was in the process of carrying it out, no matter how difficult the campus environment became. She wore a sense of 'cool' like an expensive garment that she would never do without and had little tolerance for anyone who was 'uncool'.

Sally: A 20 year old junior, majoring in pharmacy. Sally was a study in complexities. While she was unhappy with the education available to her in her rural hometown, she looked to her older sister as a role model in educational matters. There were any number of times that one clearly explained response would be contradicted by a later one. She was able to explain how she felt at a particular time in the past in the voice of the person that she was at that time. In many instances, that person was

quite different from the person she was in the present. This was different from most of the respondents, who described the past in retrospect.

Dick: A 21 year old junior, majoring in physics. In addition to the science courses he completed in high school, he also took a number of advanced mathematics courses. He was the cynic of the group. He came to Rustic academically prepared to compete and confronted the expectation of others that he would not do well. He also expressed what appeared to be both pain and anger when he discussed perceived injustices. He reacted to the slights of the university very deeply and found it difficult to discuss any of them openly.

Although the participants have been introduced in the previous section, space constraints preclude the the inclusion of the raw data from which the investigations draw. For a more detailed description of the raw data, please see (Hines, 1992).

The Development of Self Reliance and Autonomy

The statements made by many of the respondents including Sally and Dick upon reflection on their high school experience, indicate that they held their teachers responsible for their lack of academic preparation for college. Similarly, the statements made by many respondents including Jim, Kim, and Sally revealed that they held those closest to them responsible for telling them what they would need to know about college. All of the respondents knew at the time that they had not done what they could have to prepare for college. They admitted that they didn't

study enough, they didn't listen to the advice offered about college by their friends and families, and they didn't do very much investigation about college.

Just as many believed their academic preparation for college was not as good as they wanted it to be, their early college grades were also not what they hoped for. Earning low grades sets up a crisis situation, especially for those who had always earned high grades with little effort. Thus, the need to develop appropriate study behaviors was unnecessary in completing educational tasks during primary and secondary education. In order to survive this period, these students must develop these behaviors with all due speed. Those who do so can remain in college, those who cannot are asked to leave. It is at this point that a number of students either leave the university or change their majors to non-science disciplines (Fleming, 1984). With their esteem bruised, many of those students leave the university before they are asked to do so (West, 1984). Others may not have strong support systems. Still others may have parents who hate to witness the pain of their children and encourage them to come home (Hines, 1992).

Between the time these respondents entered college and achieved upperclassmen status, they began to demonstrate the development of self reliance and autonomy. Instead of quitting, they turned their attention inward and tried to make up for what they perceived as their deficiencies. These findings seem to be in agreement with those of Trippi & Stewart (1989). By examining self-appraisal variables, SAT scores and high school grade

performance, they developed a profile of Black freshman persisters and their anticipated grade performance. They suggested that those students who persist are those who expect to perform well academically and recognize the areas that they must improve in order to be successful. The respondents did not change their majors to disciplines that were viewed as less labor intensive than science. They wanted science careers. The respondents cited the support systems they developed with family and peers as instrumental to their ability to turn inward and persist. They also held that it was important to maintain a place where they could go on campus to get help when they felt they needed it and to be affirmed in a university setting that they deemed as less than optimal.

All of the respondents had also developed strong help seeking behaviors. They didn't necessarily get help when they were new Rustic students, but they understood the necessity of doing so later and were not nearly as shy about getting the help that they need. At this stage, much less of their self-esteem was associated with having to get help.

This observation of the development of successful high school students into successful college students is not atypical according to Piagetian development theory (Hines, 1992). However, in order to maintain persistence, it is necessary to help students to develop a sense of personal responsibility for education earlier than college. It is prior to that first disappointment that college level intervention would be most helpful in order to promote persistence in science among African Americans.

RESIGNED, YET PERSISTENT

Throughout all of respondent narratives, the sense of resignation expressed by each was irrepressible. Time and time again, the respondents suggested that they were not comfortable with various aspects of the university environment, but they were determined not to be dispirited by conditions they lacked the power to change. In other words, while the respondents understood the university environment, they felt powerless to change it and were resigned to the inevitability of their discomfort with the environment. The level of importance of having access to an excellent quality of education certainly was given a higher priority than personal comfort. These students placed their goals for education at such a high premium that education emerged as the primary motivation and a major factor in their persistence.

None of the respondents conveyed a sense of being able to change the climate of the university as it affected them. They were not revolutionaries. The respondents had developed a greater sense of responsibility (i. e., self reliance and autonomy) during college years, but they did not appear wholly to take an assertive stance when they encountered racism, sexism or stereotypical behavior. Rarely did they choose to challenge individuals involved in an incident that made them uncomfortable. They never reported such incidents to university authority figures. Their involvement in campus organizations whose goals included the promotion of racial harmony was only peripheral. With graduate and professional school on the horizon, their focus was on continued grade improvement.

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Conversely, the observation that the self reliance and autonomy in these respondents may not have been as highly developed in issues regarding the uncomfortable university environment may also be interpreted in another manner. While the respondents recognized the uncomfortable university environment, they chose to turn inward and concentrate on how they would react to it. Their primary interest was not in changing the minds of others around them. They were most interested in looking beyond Rustic. This can also be interpreted as a highly developed sense of self reliance and autonomy because the respondents actively chose to devote their attention to the academic rather than the social/environmental issues of the campus.

Whatever the interpretation of the data with regard to the development of self reliance and autonomy, it seems reasonable to say that silence in the face of discriminatory behavior did not aid their course. For some, such resignation may act as a motivator to complete the learning task. But for most, as indicated by the retention studies, it is defeatist. Thus, it is necessary to reduce the factors that lead to alienation, first to attract a greater number of African American students to campus and second to increase persistence of African American students in the sciences.

PRODUCT VS. PROCESS

The respondents in this study became interested in science careers at very young ages. Although they did not know very many substantive details about their choice of disciplines and the

demands they would encounter, they remained convinced that those careers were the ones they wanted to pursue. These beliefs were based on very little fact. Similarly, it is safe to allege that those who chose not to pursue those careers or disciplines based their decisions on just as few facts. The lack of facts may also be a factor in the change of majors and the absence of persistence among African American students.

The respondents strongly believed it was the responsibility of teachers to better prepare them for the realities of academia. They also expected them to teach students about career choices and what was required for success in their careers. Whether or not such expectations are fair to the teachers, they implied that such shortcomings worked against persistence in science.

When considering in combination the paucity of facts surrounding the decision to pursue a particular major with the perception of the merits of a particular profession, the process vs. product dimension of the data can be examined. The respondents were more motivated to persist in science by the profession that they wanted to pursue, than by love of the discipline associated with the profession. Although they chose to learn the commensurate science, in many instances they did so because of their career aspirations. With consideration to the responses offered concerning the negative interactions associated with studying science at Rustic, it is not entirely clear whether they would choose to persist in the study of science if it was not needed for their chosen profession. Many science educators believe that the way to assist students in persisting in science

is to make the curriculum as fascinating and engaging as possible. While this, in part should be a goal, the examination of the responses offered by the students in this study indicate an added component in promoting persistence. Science educators may also need to redesign their curricula to include more specific information on science careers that students may aspire to in order to aid persistence. By doing so, they may also pique the interest of a greater number of those students who ordinarily would not have chosen to pursue scientific careers.

FACTORS INFLUENCING PERSISTENCE

What made these African American students choose to stay in an uncomfortable environment? One of the major factors has to do with feeling. All of the respondents indicated that they had enjoyed strong support from family, friends, and in some cases, high school teachers. This helped them persist even though White faculty seemed at best, detached.

The parental expectation of success also was a major factor. These respondents did not want to disappoint their parents and in the face of difficulties, chose to tough it out rather than have to come home without their degree from Rustic. Many others believed that if they did not complete the requirements for their majors those who questioned their decision to attend Rustic were likely to say, 'I told you so'. These factors influenced their decision to persist in science and persevere at the institution. In light of these factors, the following section offers some recommendations for science education and science educators.

Another factor in persistence related to the quality of education the respondents believed they were receiving at Rustic. They knew that Rustic was not the only school where they could receive quality education but it was the best in the immediate area. The respondents were used to attending school close to home and all wanted to continue to do so. Thus, leaving Rustic would serve no purpose since the campuses they would have chosen to attend would mirror Rustic and would be further from home. Since some believed the type of campus environment they associated with Rustic was pervasive at other institutions as well, they saw no benefit in transferring.

In summary, the factors influencing persistence among African American upperclassmen in natural science and science related majors at Rustic University are: 1) a strong support system comprised of family, friends and home community members; 2) parental expectation of success in college and a desire not to disappoint parents; and, 3) focus on the quality of educational opportunities offered by the university and the necessity of taking advantage of them.

DISCUSSION

There are a number of reasons why it is important to increase the representation of ethnic minorities in scientific careers. Here are a few: First, with the anticipated shortage of scientists, underrepresented minority groups should be cultivated as a source of personnel (Wiley, 1989). Continuing demographic shifts in the population of the United States makes it necessary

for us to modify our conception of who can and should become scientists. Gallon (1990) ties this notion to our scientific community's relationship to global economics and national prosperity:

> So, what does the United States need to regain its economic superiority? Clearly we need to regain our ability to innovate. Most important, however, is the assurance of an educated, skilled, and motivated workforce. This country must educate all of its people-- especially children-- to compete with the foreign workforce. (p. 1).

Second, a positive economic and social impact on minority communities may be a foreseen outcome, since an increased income and opportunity would follow scientific and technical training (Mincy, 1989). Third, participation in scientific endeavors by those whose ancestry, heritage, and outlook differ from those who have historically defined science in the West may infuse new, fresh and useful ideas. Creative solutions to present and future problems may be offered from a difference in outlook.

Continuing, it is imperative that this nation keep a greater pool of its creative talent in scientific pursuits, if it is to regain and maintain its preeminence in science and technology. Consequently, serious examination of this question is required if we are to ever provide the types of nurturing environments necessary to produce scientists from all sectors of the larger community. In the past, historically Black colleges could produce as many scientists among their students as could find their place

in the scientific enterprise. That is no longer true. What is now needed is an understanding on the part of other universities of this problem if the present need is to be met.

REFERENCES

Allen, W. (1988). Black students in U. S. higher education: Toward improved access, adjustment and achievement. Urban Review, 20, 165-188.

Alsalam, N. (Ed.). (1991). The condition of education 1990: volume 2, postsecondary education. Washington, DC: National Center for Education Statistics.

Bogden, R. C. & Biklen, S. K. (1992). Qualitative research for educators (2nd ed.). Boston: Allyn and Bacon.

Boyd, W. M. (1974). Desegregating America's colleges. New York: Praeger.

Changing America: The new face of science and mathematics. Washington, DC. (ERIC Document Reproduction Service No. ED 317 386)

Cross, P. H. and Astin, H. S. (1981). Factors affecting Black students' persistence in college. In G. E. Thomas, Black students in higher education: Conditions and experiences in the 1970's, (pp. 76-90). Westport, CT: Greenwood.

Directory of HBCUs & other predominantly Black colleges and universities, 1992. (1992b). Black Issues in Higher Education, 9(13), 68-69.

Fleming, J. (1984). Blacks in college: A comparative study of students' success in Black and in White institutions. San Francisco: Jossey-Bass.

Friedman, D. L. (1990). Minorities in engineering school: A data base for retention efforts. Washington, DC: National Action

Council for Minorities in Engineering. (ERIC Document Reproduction Service No. ED 326 593)

Gallon, D. P. (Ed.). (1990). Regaining the edge in urban education: Mathematics and sciences. Washington, DC: American Association of Community and Junior Colleges. (ERIC Document Reproduction Service No. ED 341 450)

Hines, S. M. (1992). Persistence in science disciplines at major research universities: The African American upperclassman's perspective. Unpublished manuscript.

Massey, W. E. (1992). A success story amid decades of disappointment. Science, 258, 1176-80.

McCracken, G. (1988). The long interview. Newbury Park, CA: Sage Publications.

Melnick, V. L. and Hamilton, F. D. (1981). Participation of Blacks in the basic sciences: An assessment. In G. E. Thomas, Black students in higher education: Conditions and experiences in the 1970's, (pp. 76-90). Westport, CT: Greenwood.

Mincy, R. B. (1989). Paradoxes in Black economic progress: Incomes, families, and the underclass. Journal of Negro Education, 58(3), 255-269.

Sims, C. (1992). What went wrong: Why programs failed. Science, 258, 1185-87.

Smith, E. F. (1990). Toward greater success for minority students on predominantly White college campuses. University of Texas at Austin. (ERIC Document Reproduction Service No. ED 333 306)

Tesch, R. (1990). Qualitative research: Analysis types & software tools. New York: Falmer Press.

The Nation. (1992). The Chronicle of Higher Education, 39, 3-37.

The 25 Best Colleges. (September, 1992). US News and World Report, 113(12), 70-90.

Top degree producers by disciplines; Baccalaureate degrees conferred 1988-1989. (1992). Black Issues in Higher Education, 9(5), 34-42.

Trippi, J. and Stewart, J. B. (1989). The relationship between self-appraisal variables and the college grade performance and persistence of Black freshmen. Journal of College Student Development, 30(6), 484-91.

West, S. A. (1984). Black students' experiences on a predominantly White college campus: An ethnography. Ann Arbor: University Microforms International.

Wiley, E., III. (1989). Minorities key to maintaining nation's competitive edge, analysts says. Black Issues in Higher Education, 5(23), 13.

Wilson, M. R. (1992). (ERIC Document Reproduction Service No. ED 346128).

Wilson, R. (1987, February). Recruitment and retention of minority faculty and staff. American Association of Higher Education-Bulletin, 11-14.

Young, H. A. (1983). Cultural differences that affect retention of minority students on predominantly White campuses. Paper presented at the Annual Meeting of the American Educational

Research Association, Montreal, Quebec, Canada. (ERIC Document Reproduction Service No. ED 233 100)